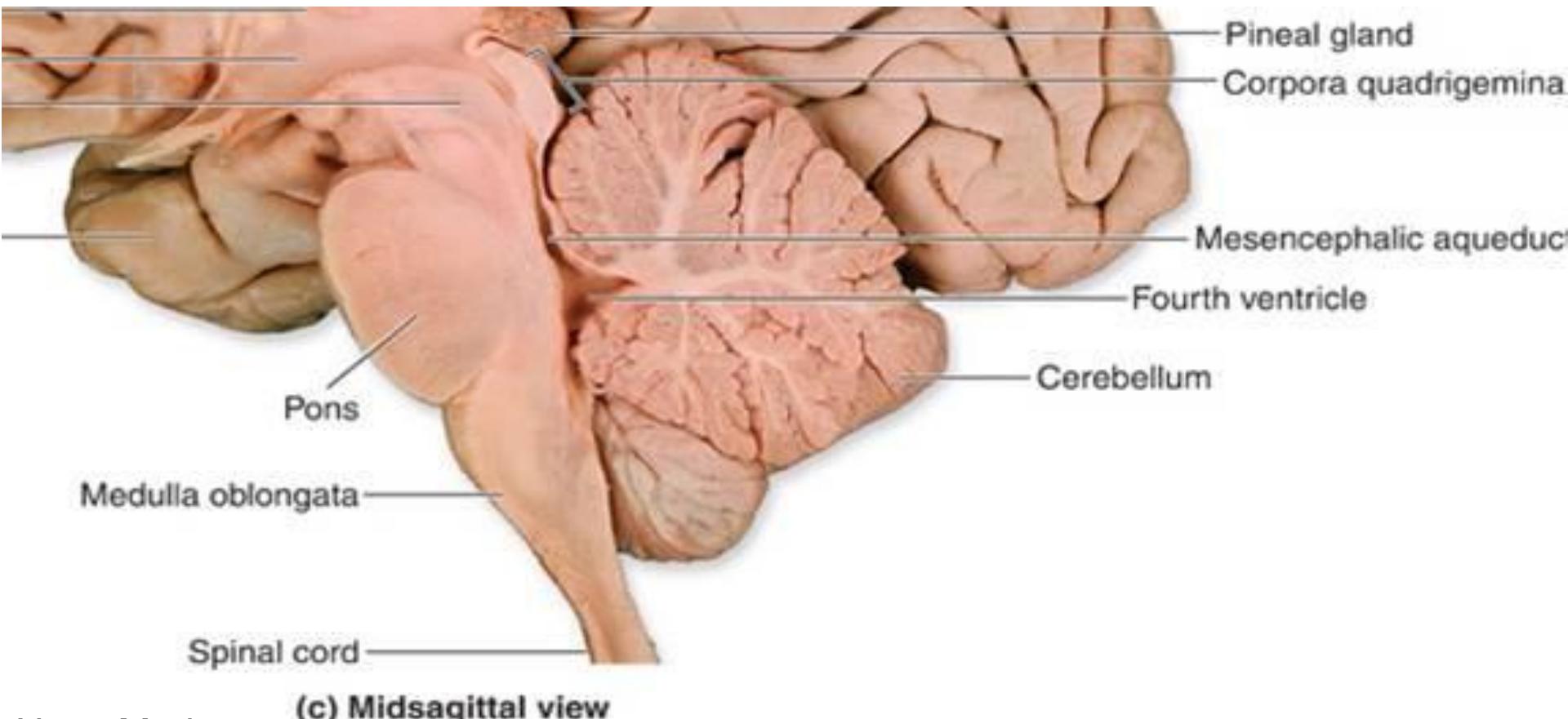


Cerebellum

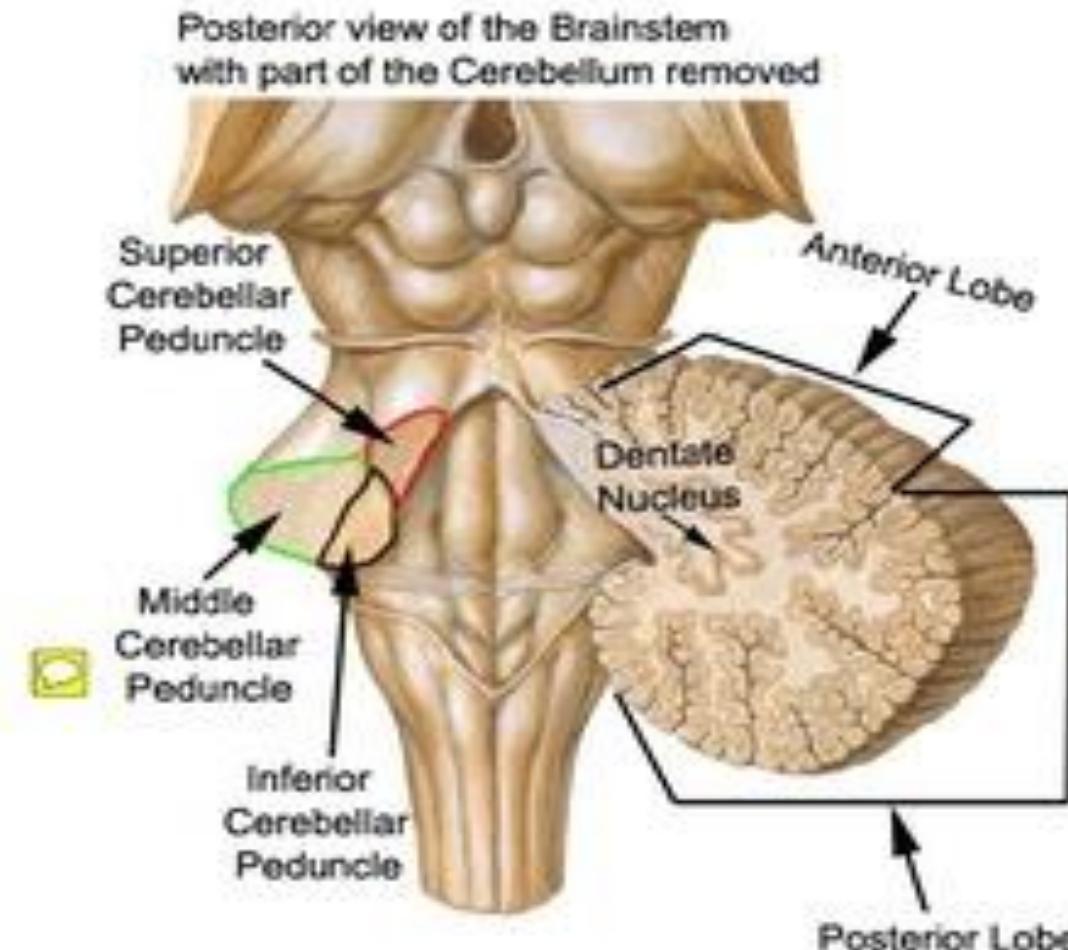
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Introduction

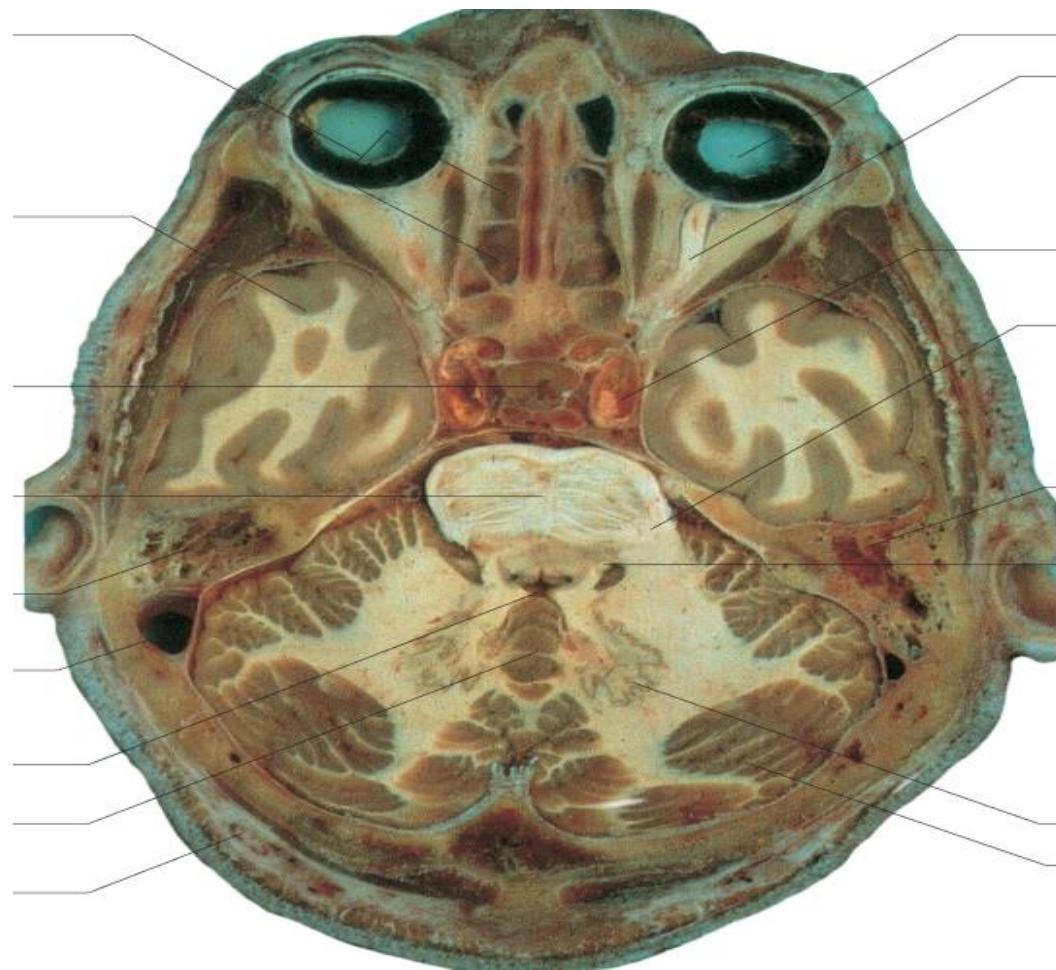
- **Cerebellum** is the largest part of the hindbrain situated dorsal to the pons and medulla, and separated from them by the fourth ventricle.
- Weighs about 150 g.



- Connected to the brain stem by pair of
 - Superior cerebellar peduncle – **midbrain**
 - Middle cerebellar peduncle – **pons**
 - Inferior cerebellar peduncle – **medulla oblongata**



- Occupies posterior cranial fossa, where it is covered by tentorium cerebelli and present and behind the pons and medulla oblongata.

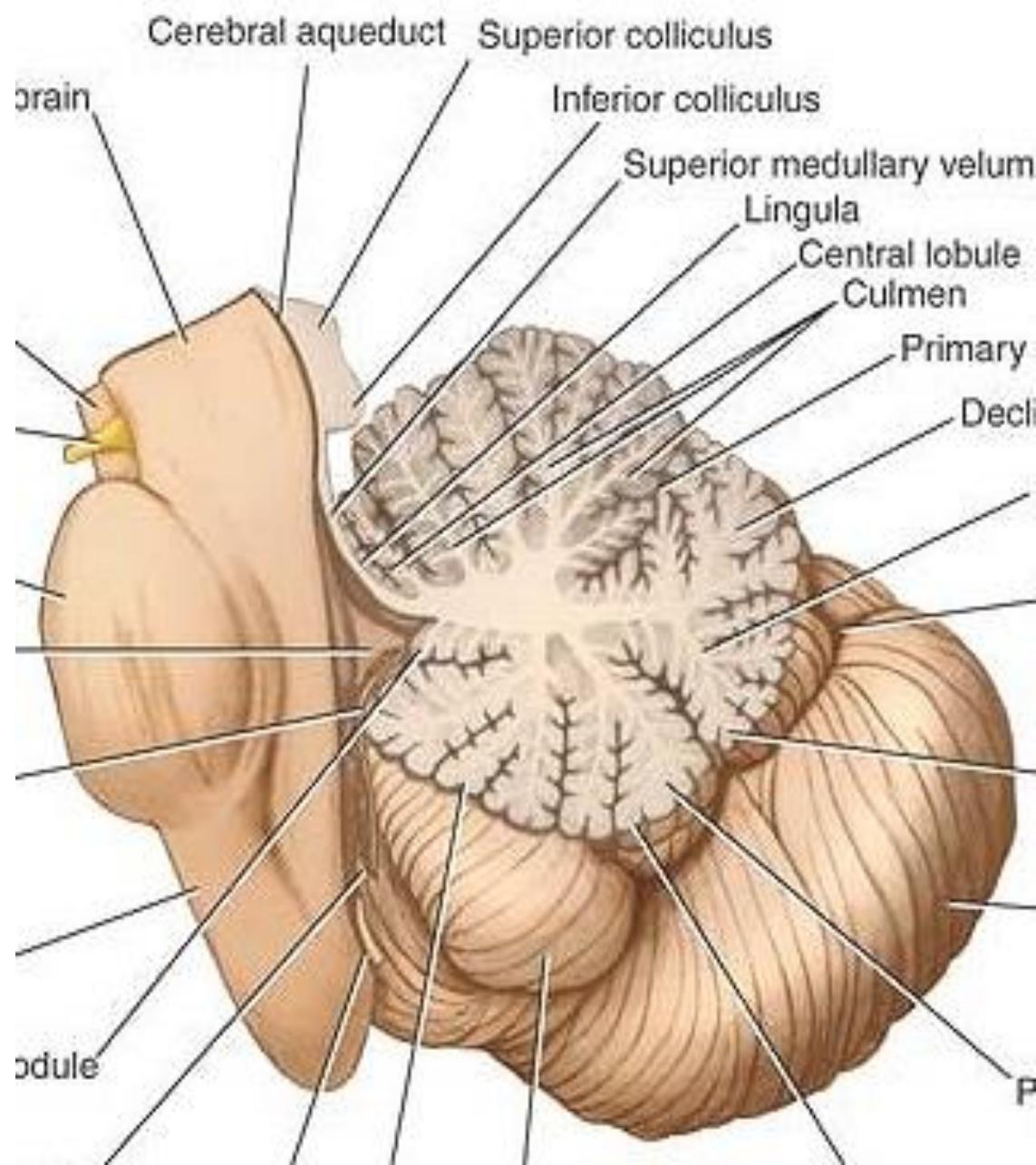


Basic Functions of the cerebellum

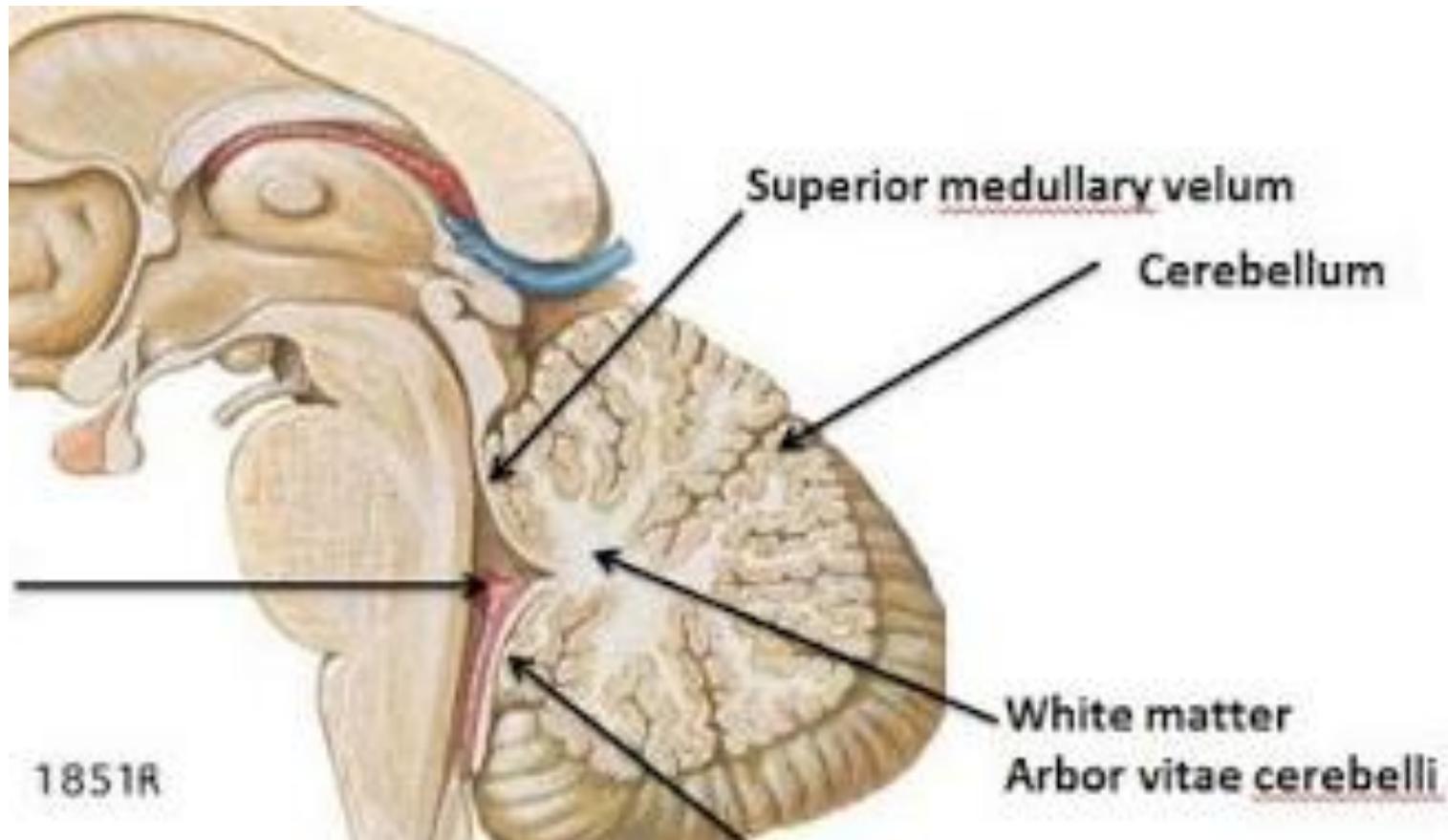
- Maintenance of equilibrium.
- Regulation of muscle tone.
- Coordination of somatic motor activities.

Gross anatomy

- Consists of outer grey matter & inner white matter & 4 pairs of **deep cerebellar nuclei**.
- Cortex is thrown into numerous of transverse folds called folia which are separated by fissures.

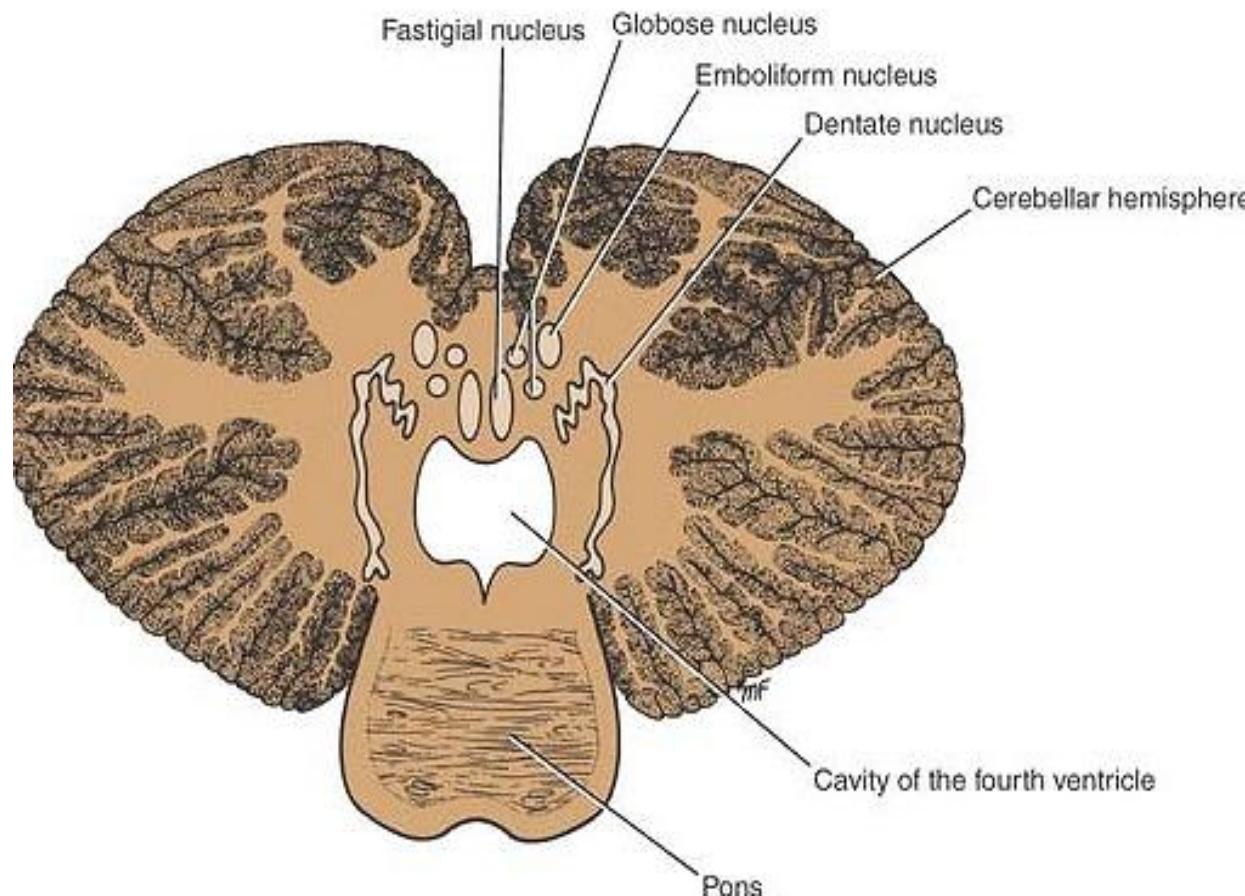


- Each **folium** contains a core of white matter covered superficially by gray matter.
- The central core of white matter being arranged in the form of the branching pattern of a tree, is called **arbor vitae cerebelli** (*arbor vitae* = tree of life).



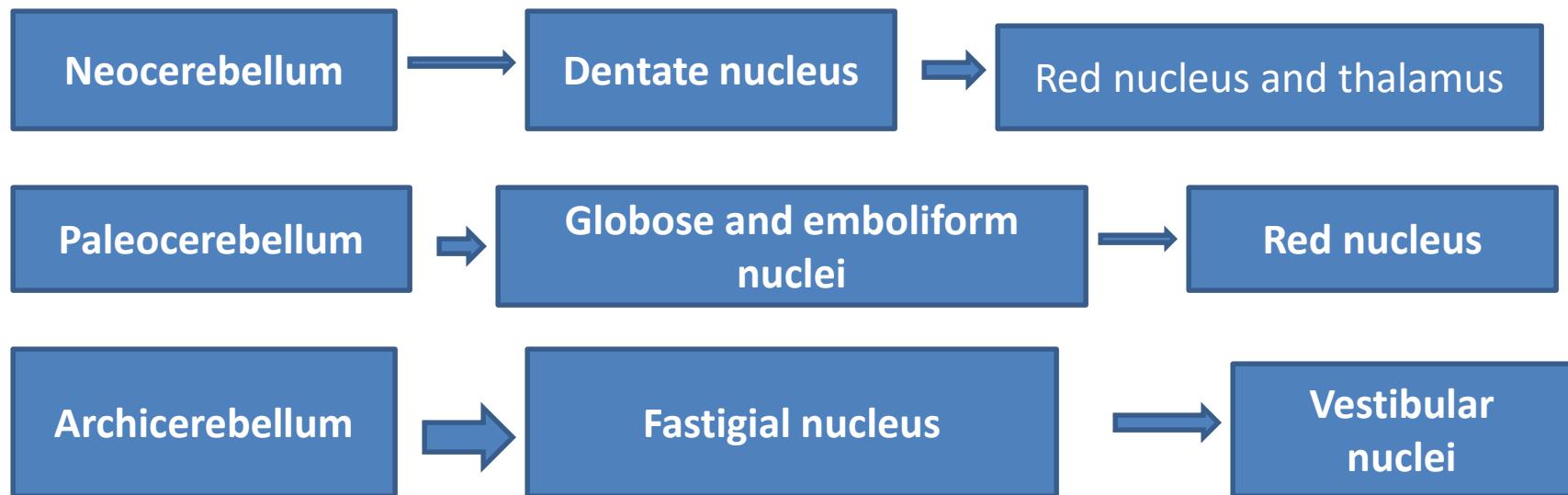
Intracerebellar Nuclei

- From lateral to medial, these nuclei are:
- The dentate
- The emboliform
- The globose, and
- The fastigial.



Intracerebellar Nuclei

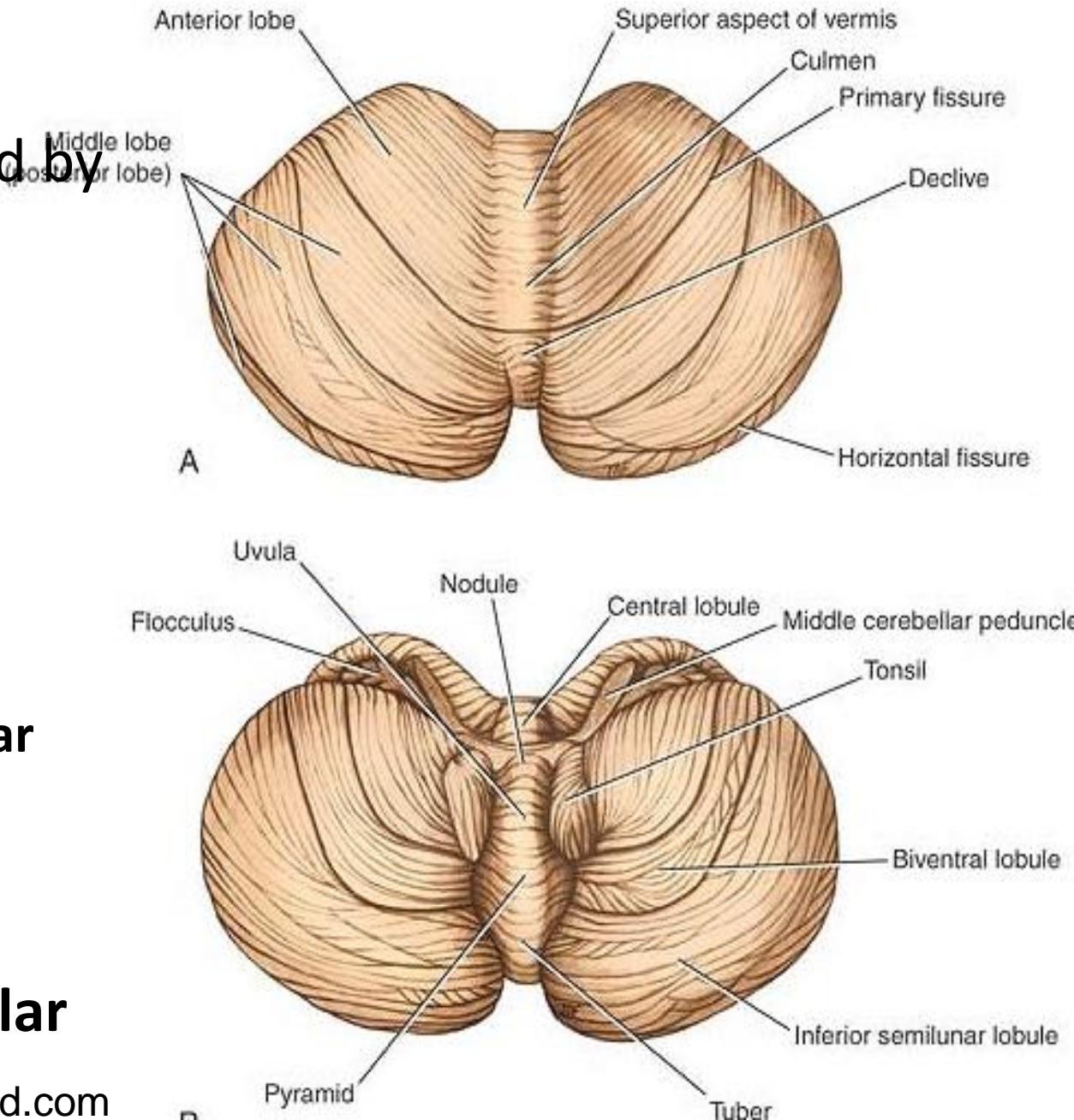
- Also called central nuclei.
- They are masses of grey matter embedded in the white matter of the cerebellum.



Nuclear connections of the cerebellum

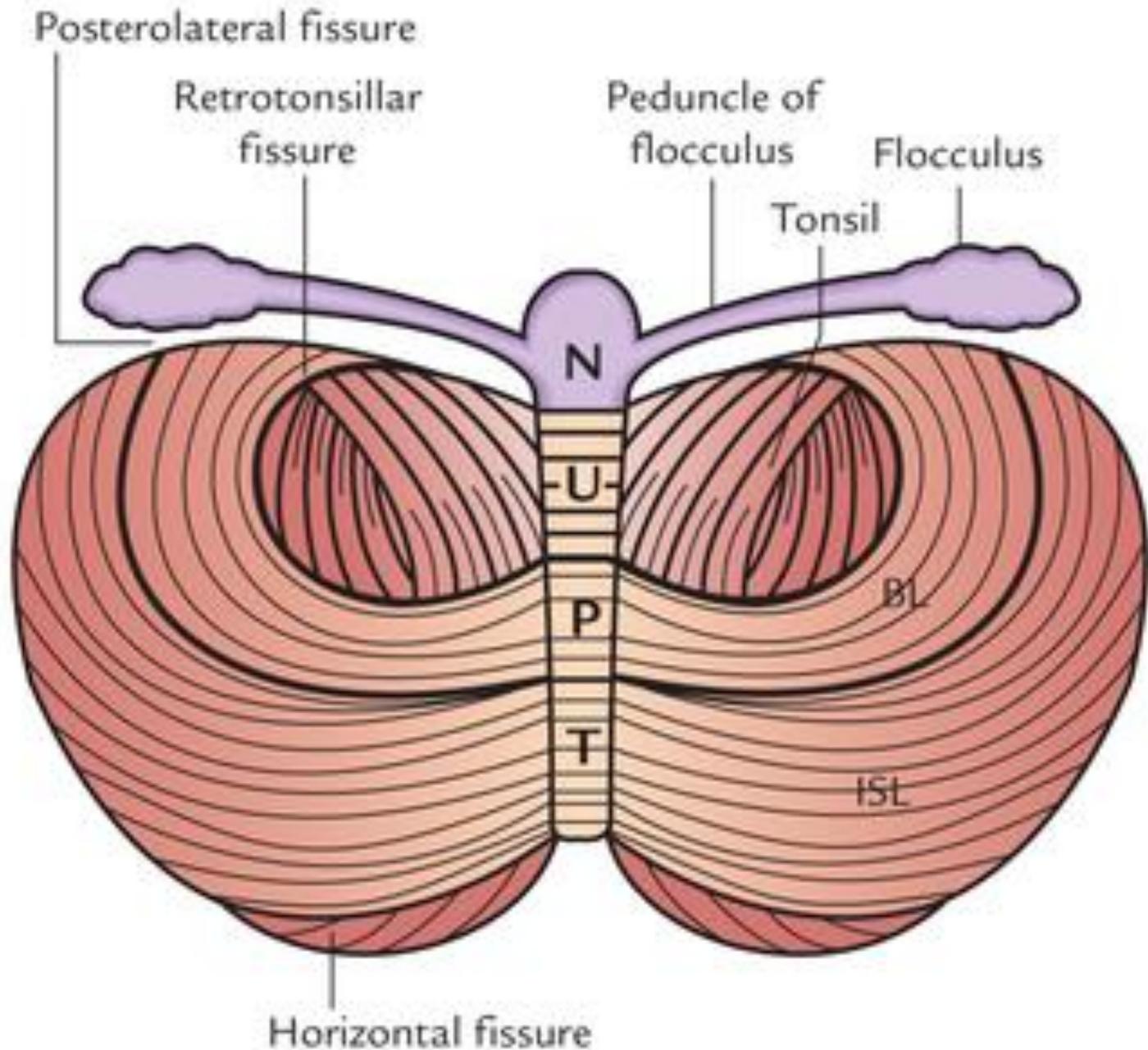
Anatomical subdivisions

- Consists of two cerebellar hemispheres joined by a narrow median vermis.
- Divided into three lobes:
 - The anterior lobe
 - The middle lobe/posterior
 - The flocculonodular lobe
- by primary and posterolateral fissure/uvulonodular fissures.

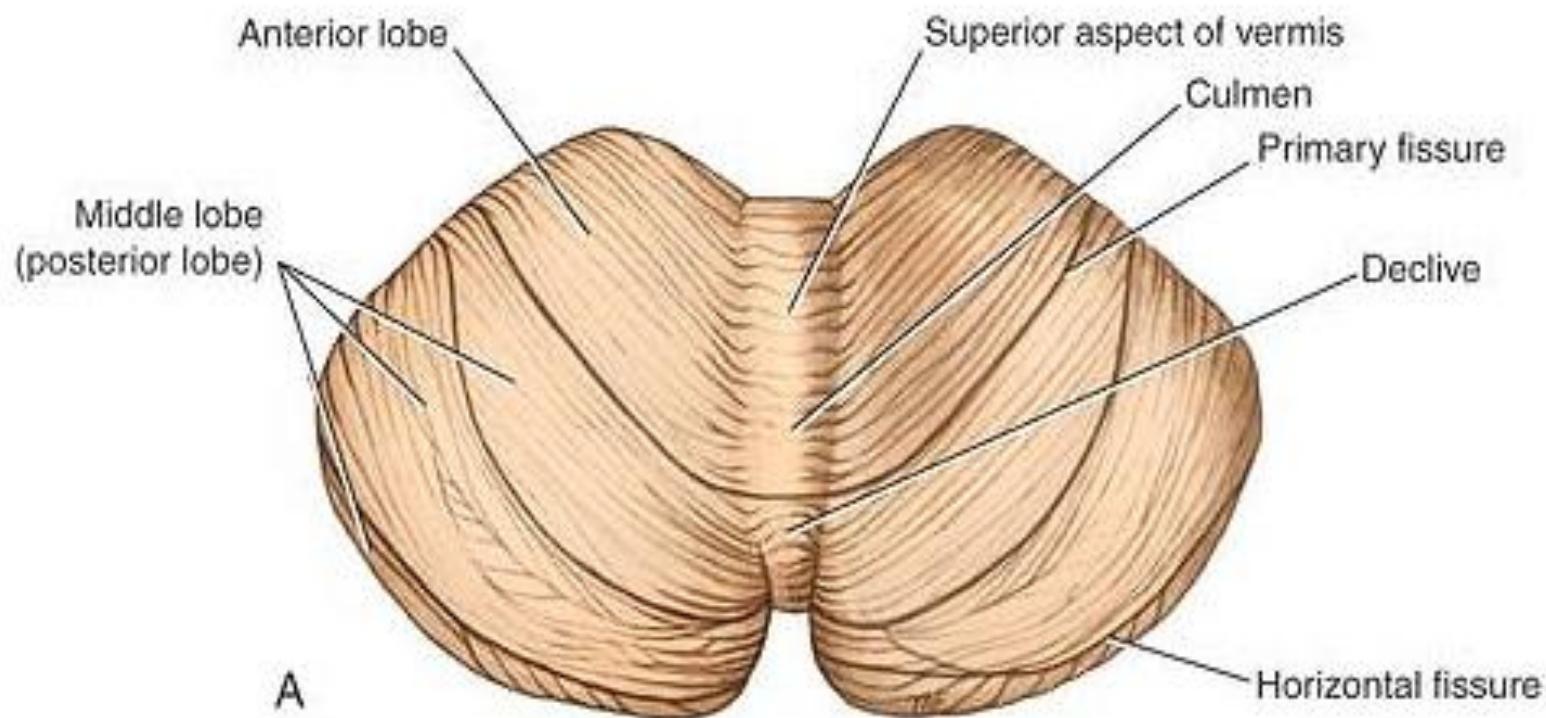


Fissures

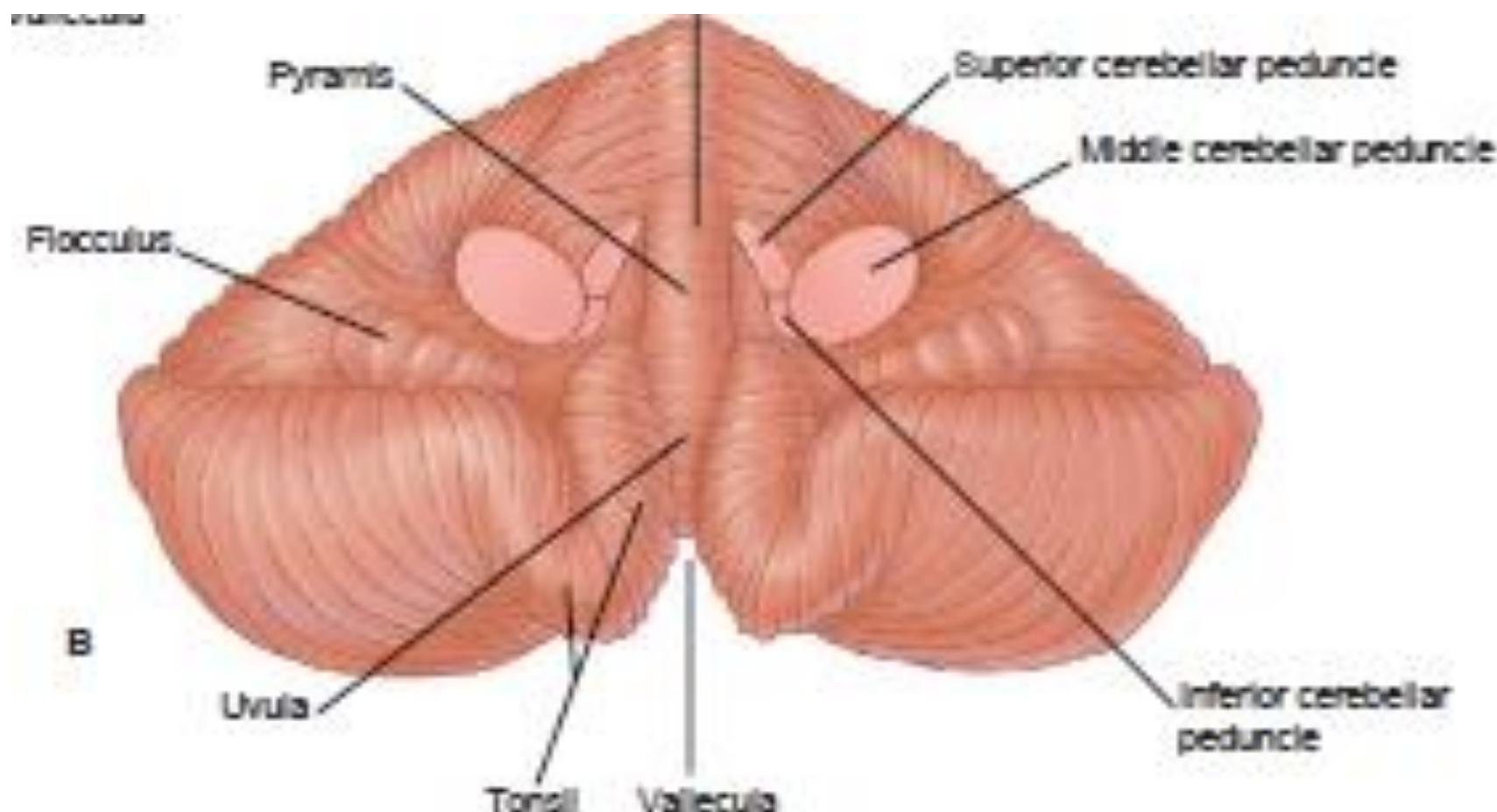
- **Posterolateral fissure** lies on the inferior surface of the cerebellum and separates the *flocculonodular lobe* from the rest of the cerebellum (*corpus cerebelli*).
- The V-shaped **fissura prima** on the superior surface cuts the superior vermis at the junction of its anterior two-third and posterior one-third. It divides the corpus cerebelli into *anterior and posterior (middle) lobes*.



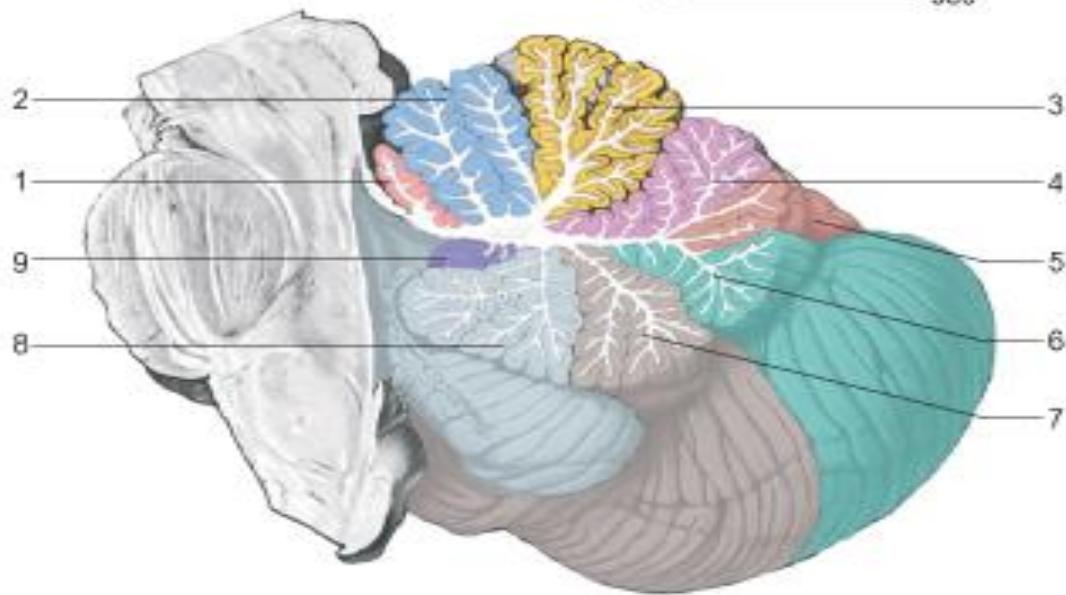
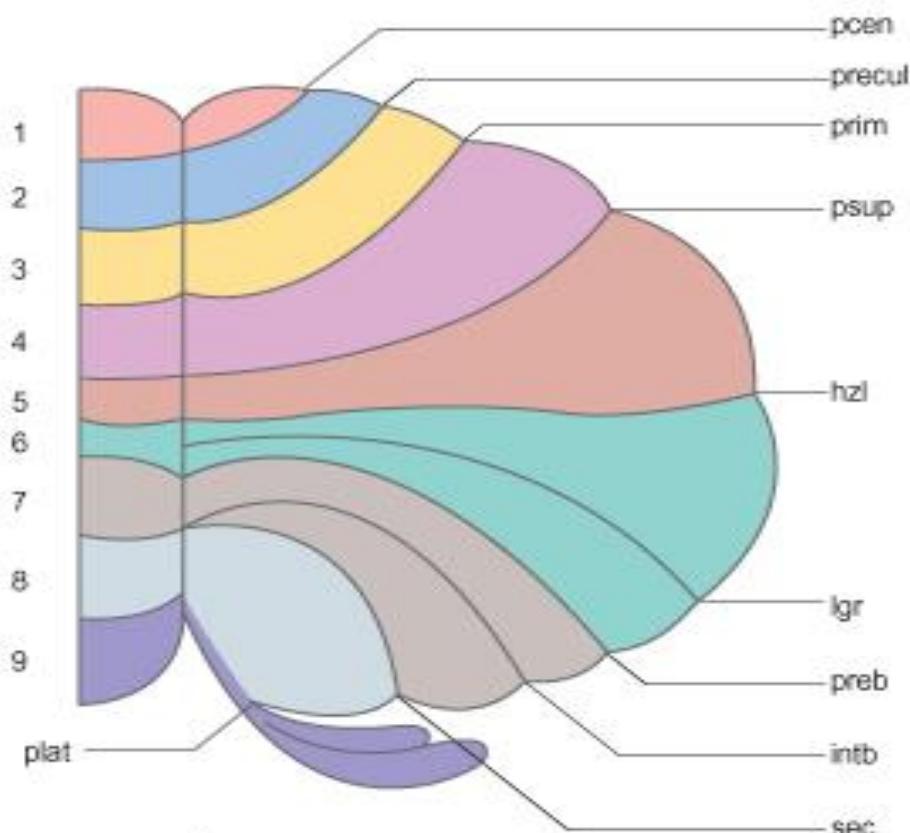
- **Horizontal fissure** separates the superior from the inferior surfaces.
- **Horizontal fissure** is most conspicuous and runs along the lateral and posterior margins of the cerebellum.

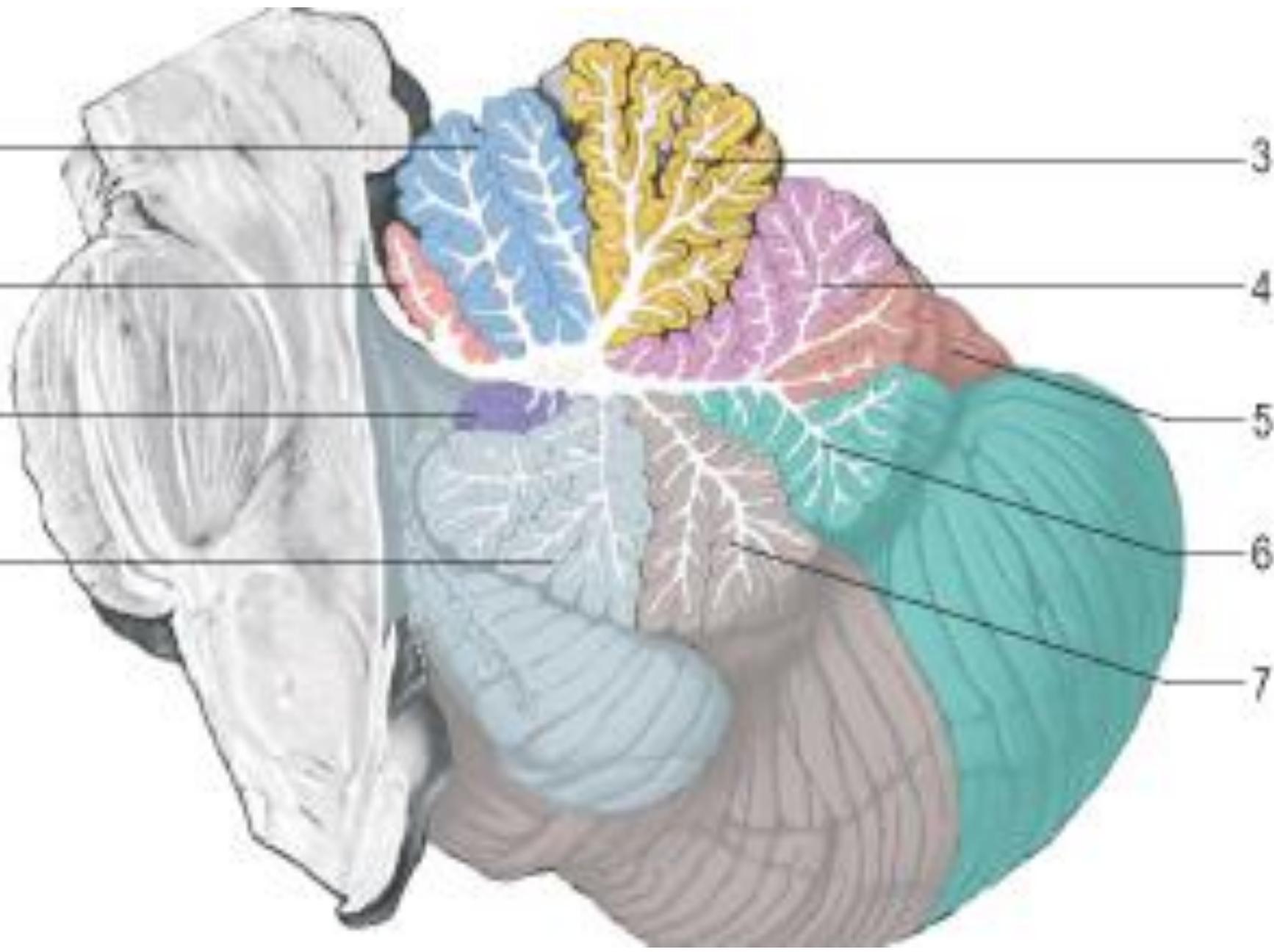


- Inferior vermis is separated from hemisphere by **vallecula**



- Ten parts of vermis
- Vermal portion of
- **Anterior lobe:** lingual central lobule & culmen
- **Middle lobe:** declive folium, tuber, pyramid, uvula
- **Flocculonodular lobe:** nodule





Morphological subdivisions

Archicerebellum:

- First to appear in evolution in aquatic vertebrates
- Includes **floculonodular lobe & lingulla**
- Receives input from **vestibular nerve & vestibular nuclei.**
- Concerned with maintenance of body **equilibrium, and posture of trunk muscles.**

Morphological subdivisions

Paleocerebellum:

- Appears next in terrestrial vertebrates.
- Includes anterior lobe except **lingula & the pyramid & uvula**.
- Receives proprioceptive & exteroceptive impulse from spinocerebellar & cuneo cerebellar tract.
- Role in maintenance of tone of voluntary muscle **posture and crude movements of lower limb**.

Morphological subdivisions

Neocerebellum:

- Last to appear with the appearance of neocerebrum.
- Includes **middle lobe except pyramid & uvula**.
- Has extensive connection with cerebral cortex through pontine nuclei.
- Concerned with regulation of **fine and skill voluntary movements**.

Functional subdivisions

- **Median zone or vermal-** project into Fastigi
- Concerned with movements of trunk & extensor muscle tone
- **Intermediate zone or para vermal-** nucleus interpositus
- Modify ipsilateral movement & flexor muscle tone
- **Lateral zone-** dentate nucleus
- Coordination of distal limb muscle for skillful act

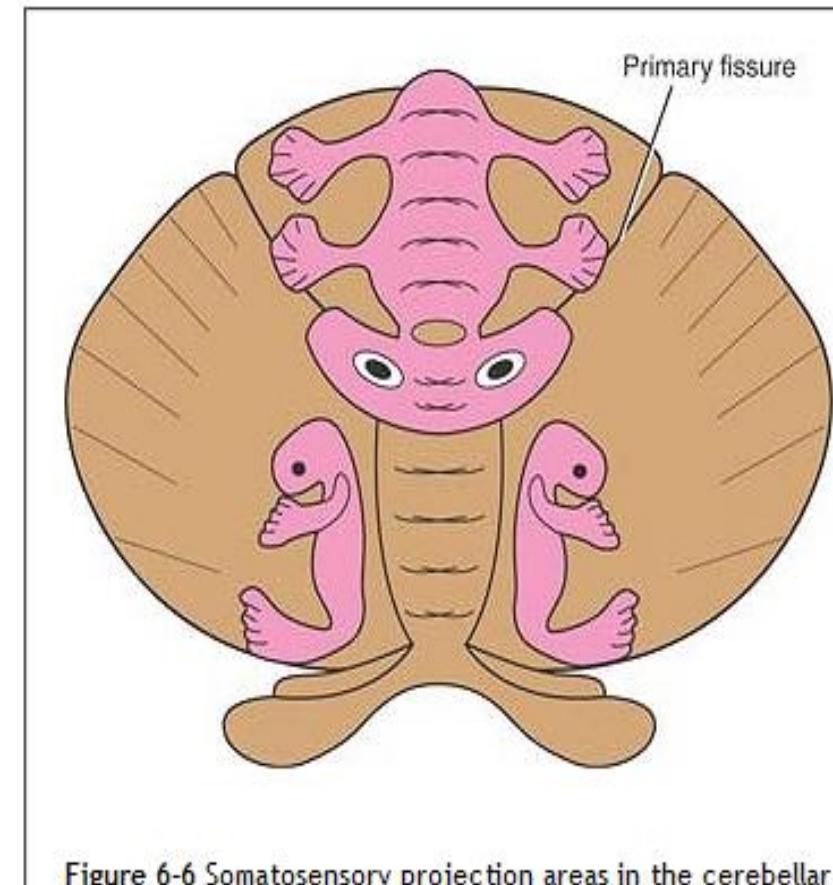
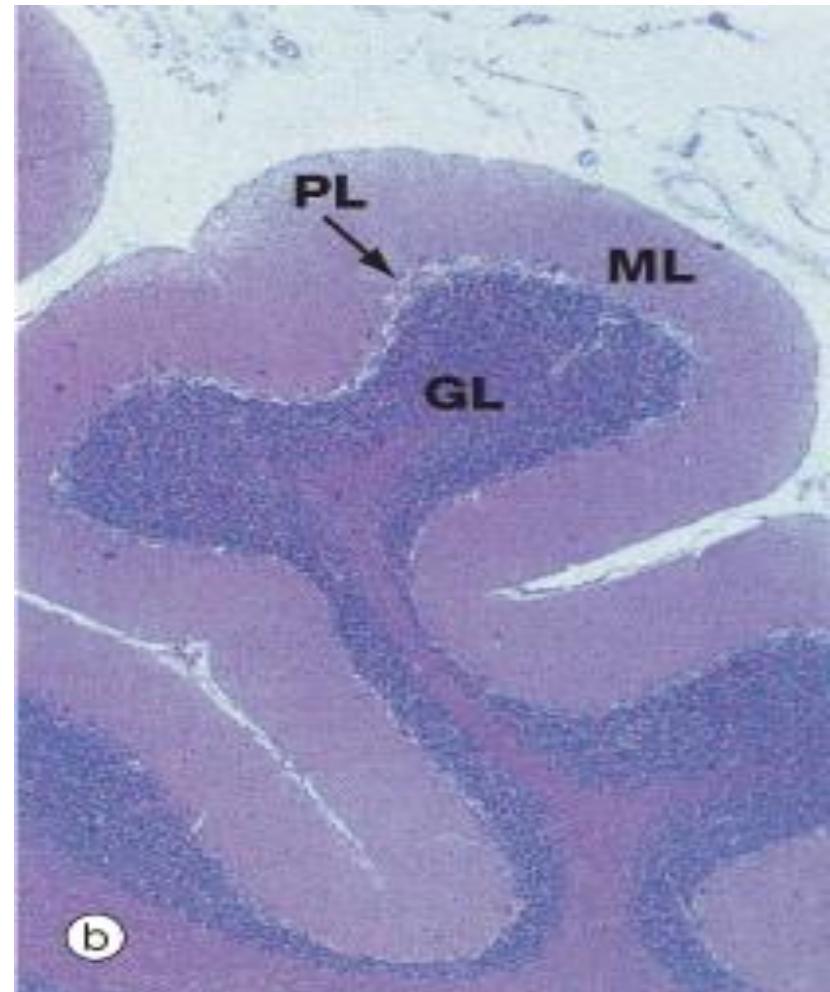


Figure 6-6 Somatosensory projection areas in the cerebellar cortex.

Microanatomy

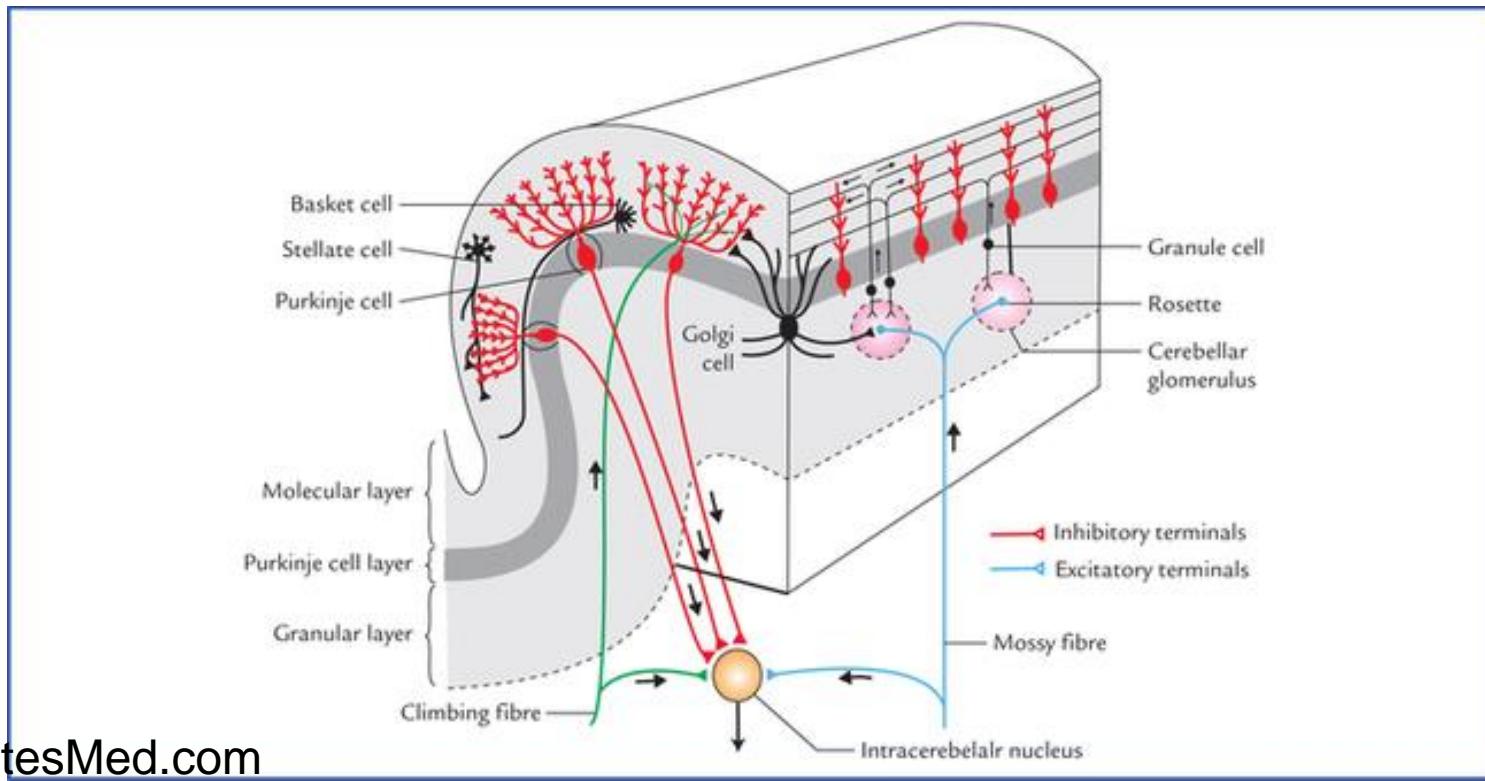
- Consists of 3 layers:
 - Molecular - outer
 - Purkinje - middle
 - Granular layer- inner
- **Molecular (Plexiform) layer:**
 - Contains the outer **stellate cell** and the inner **basket cell** & large numbers of unmyelinated fibres.



Microanatomy

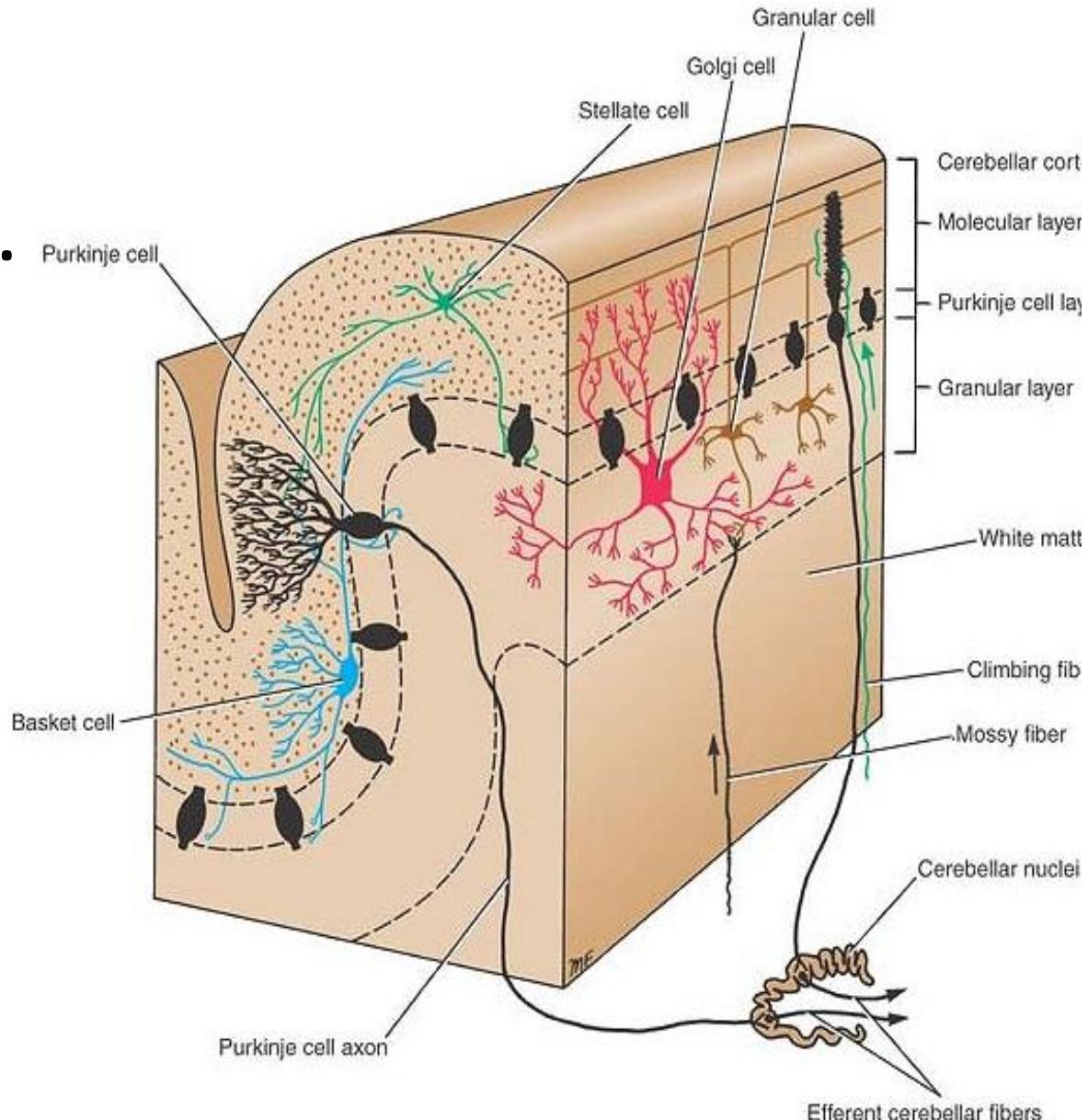
- **Purkinje Cell Layer:**

- Flask shaped and are arranged in a single layer.
- Dendrites of these cells pass into the molecular layer & undergo profuse branching.
- Axons pass through the granular layer to enter the white matter.
- Synapse with cells of one of the intracerebellar nuclei.



Microanatomy

- **Granular layer:**
 - Contain **granular cells & Golgi cells.**
 - Dendrites of the granular cells synapse with the mossy fibers.
 - Axon passes into the molecular layer, where it bifurcates at a T junction.



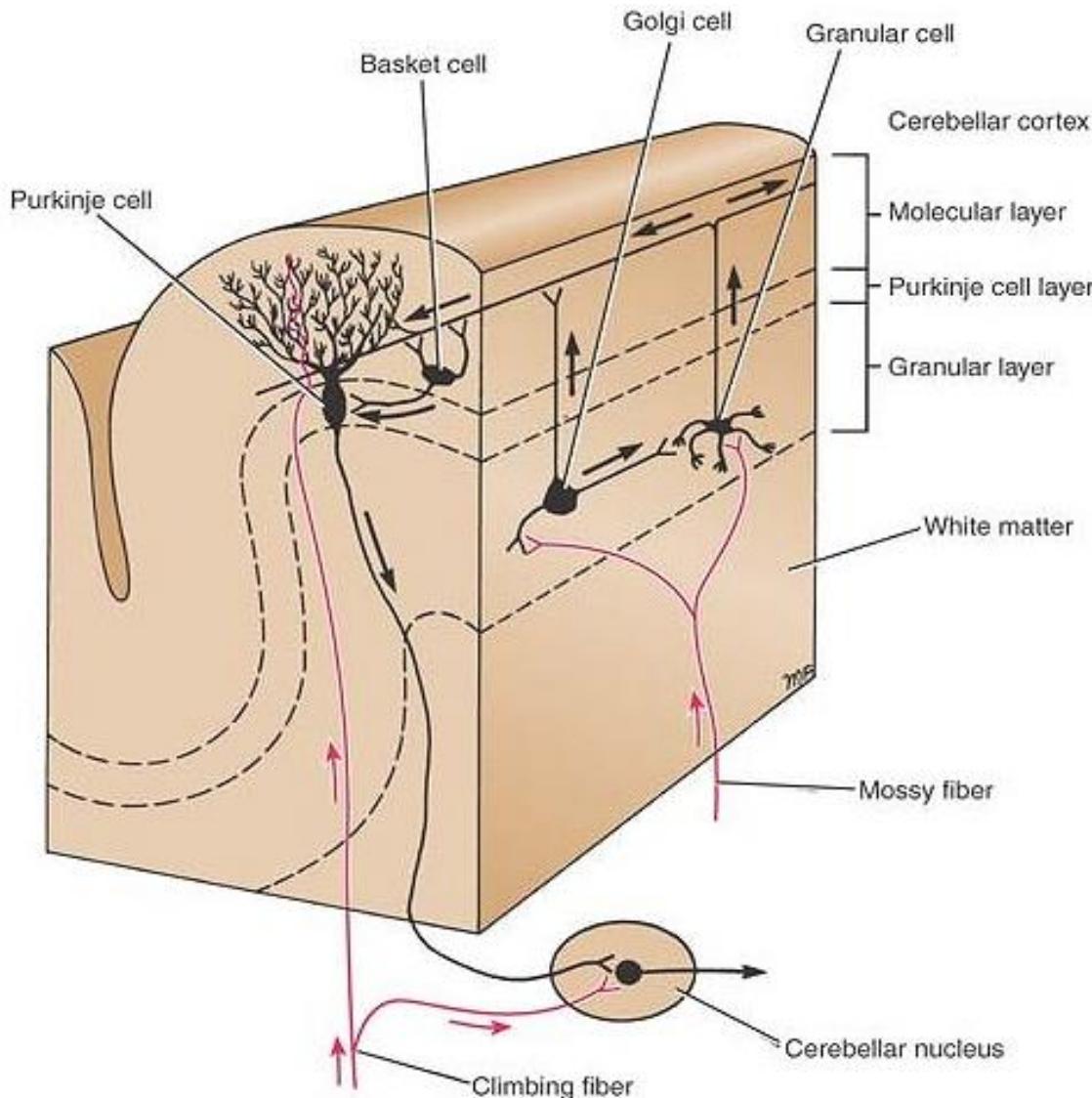
White matter

- Three groups of fibers:
 - **Intrinsic:**
 - Connect different regions of the cerebellum of the same side or two cerebellar hemispheres.
 - **Afferent:**
 - Enter the cerebellum mainly through the inferior and middle cerebellar peduncles.

White matter

- **Efferent:**

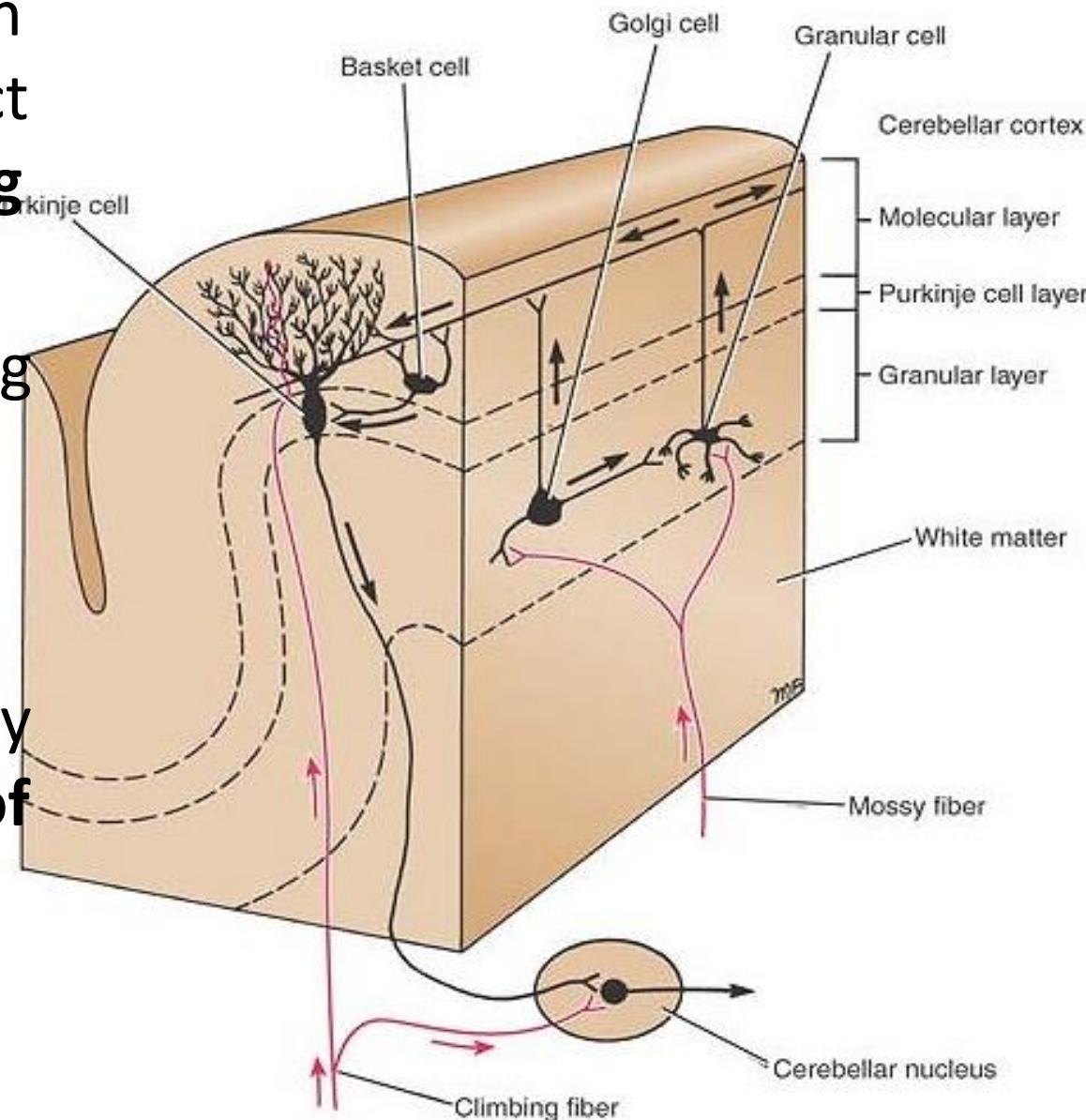
- Formed by the axons of the Purkinje cells which pass & synapse deep cerebellar nuclei.
- Fibers from dentate, emboliform and globose pass through superior cerebellar peduncle.
- Fibers from fastigial nucleus leave through inferior cerebellar peduncle.



Cerebellar cortical mechanism

- **Climbing fibers** are the terminal fibers of the **olivocerebellar tract**.
- **Mossy fibers** are the terminal fibers **of all other cerebellar afferent tracts**.
- Climbing and mossy fibers are **excitatory to Purkinje cells** through **granular cells**.
- Rest of the cells are inhibitory which modify the motor activity.
- Purkinje cells form the center of a functional unit of the cerebellar cortex.

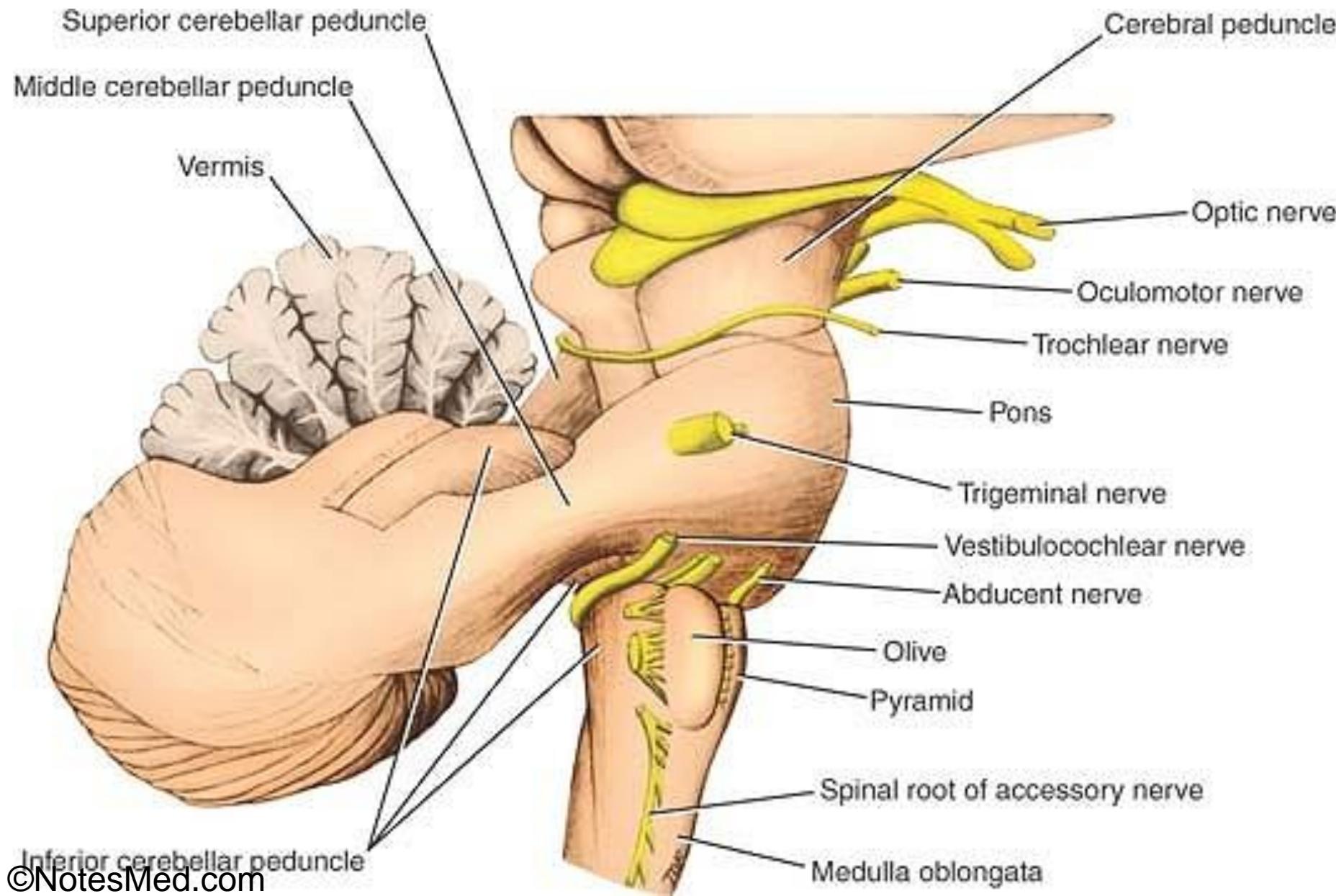
- **Single Purkinje neuron** makes synaptic contact with only **one climbing fiber**.
- However, one climbing fiber makes contact with 1 to 10 Purkinje neurons.
- **Single mossy fiber** may stimulate **thousands of Purkinje cells** through the granule cells.



Deep cerebellar nuclear mechanism

- Receives inhibitory axon from Purkinje cells.
- Excitatory axon from climbing and mossy fibers.
- Efferent information for brain and spinal cord leave through these nuclei.

Cerebellar peduncles



Cerebellar peduncles

- **Inferior cerebellar peduncle:**
 - Formed on the posterolateral aspect of the upper half of the medulla oblongata.
 - Consists of a large number of afferent and efferent fibres.
 - *Inferior cerebellar peduncle consists mainly of afferent fibres to the cerebellum from the spinal cord, the olfactory nuclei, the reticular formation of the medulla, and the vestibular nuclei and nerve.*
 - *Also transmits a few efferent fibres from the cerebellum to the medulla, principally to the vestibular nuclei and reticular formation.*

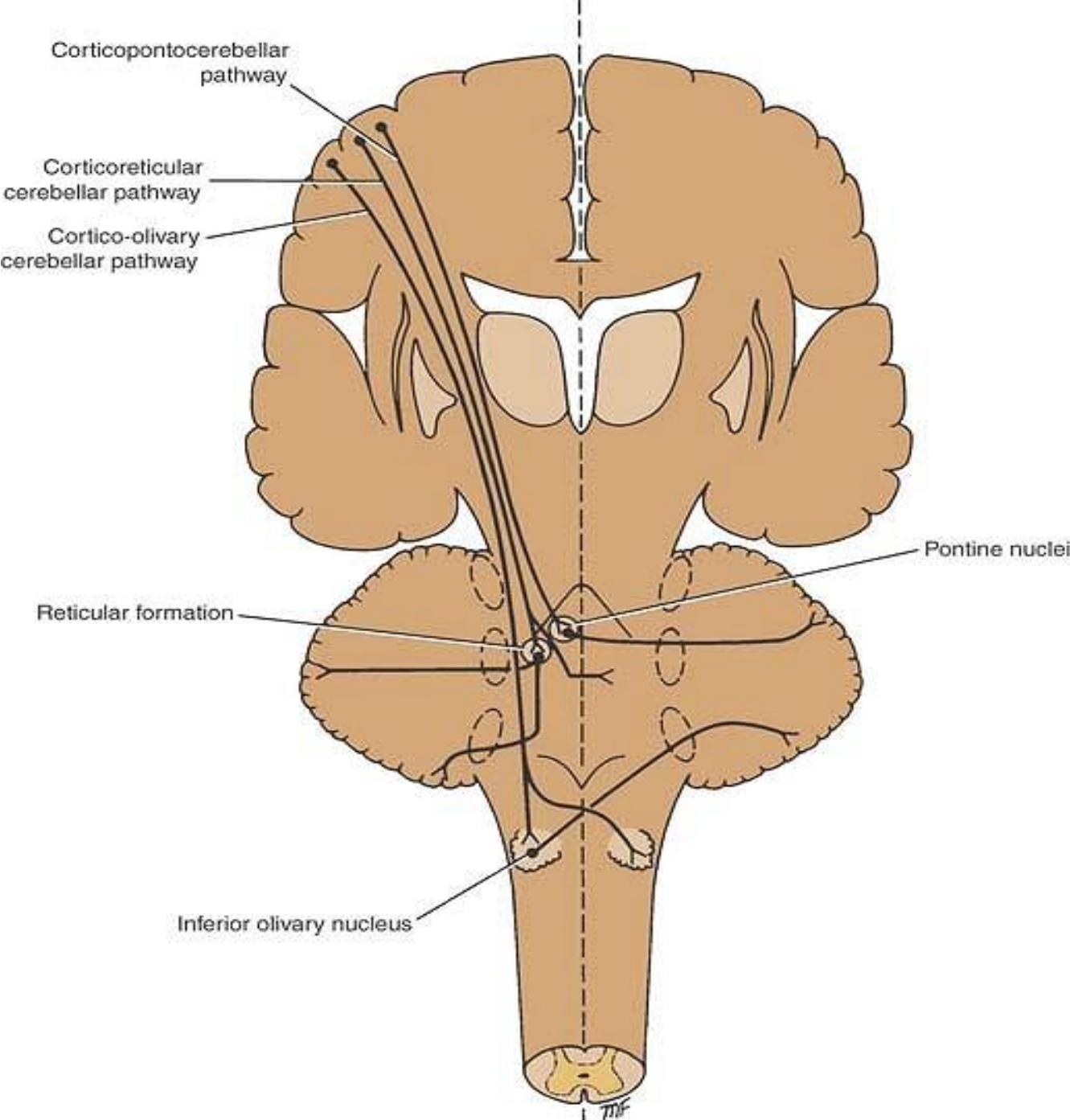
Cerebellar peduncles

- **Middle cerebellar peduncle:**
 - The largest of the three peduncles.
 - Formed at the posterolateral margin of the pons.
 - *Consists of only afferent fibres which arise from the pontine nuclei of the opposite side.*

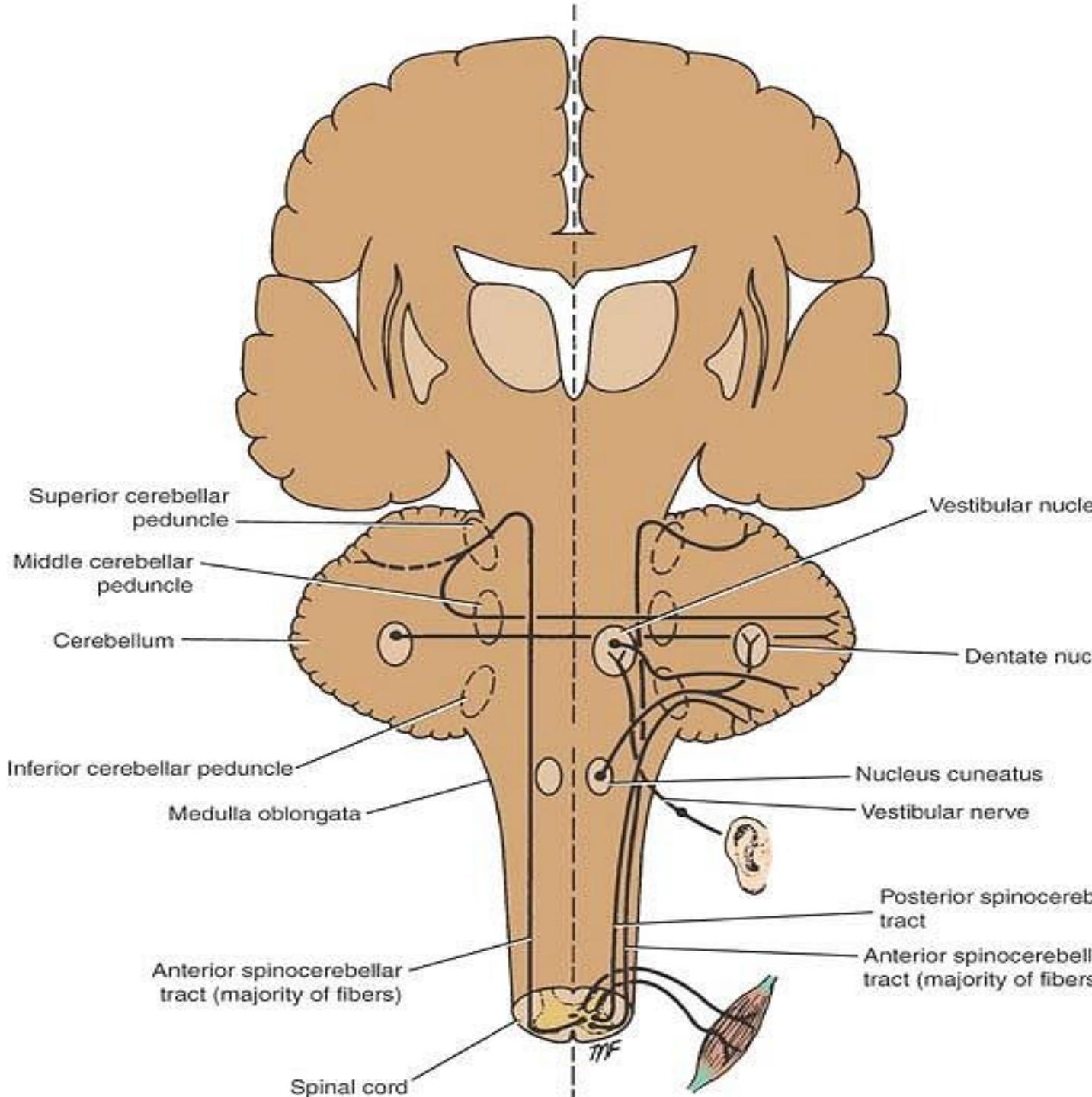
Cerebellar peduncles

- **Superior cerebellar peduncle:**
 - Emerges from the anterior cerebellar notch and forms the lateral boundary of the upper half of the 4th ventricle.
 - *Mainly consists of efferent fibres passing from the dentate nucleus to the red nucleus, thalamus and cerebral cortex of the opposite side.*
 - *It is the principal efferent pathway from the cerebellum and its fibres arise mainly in the dentate nucleus.*

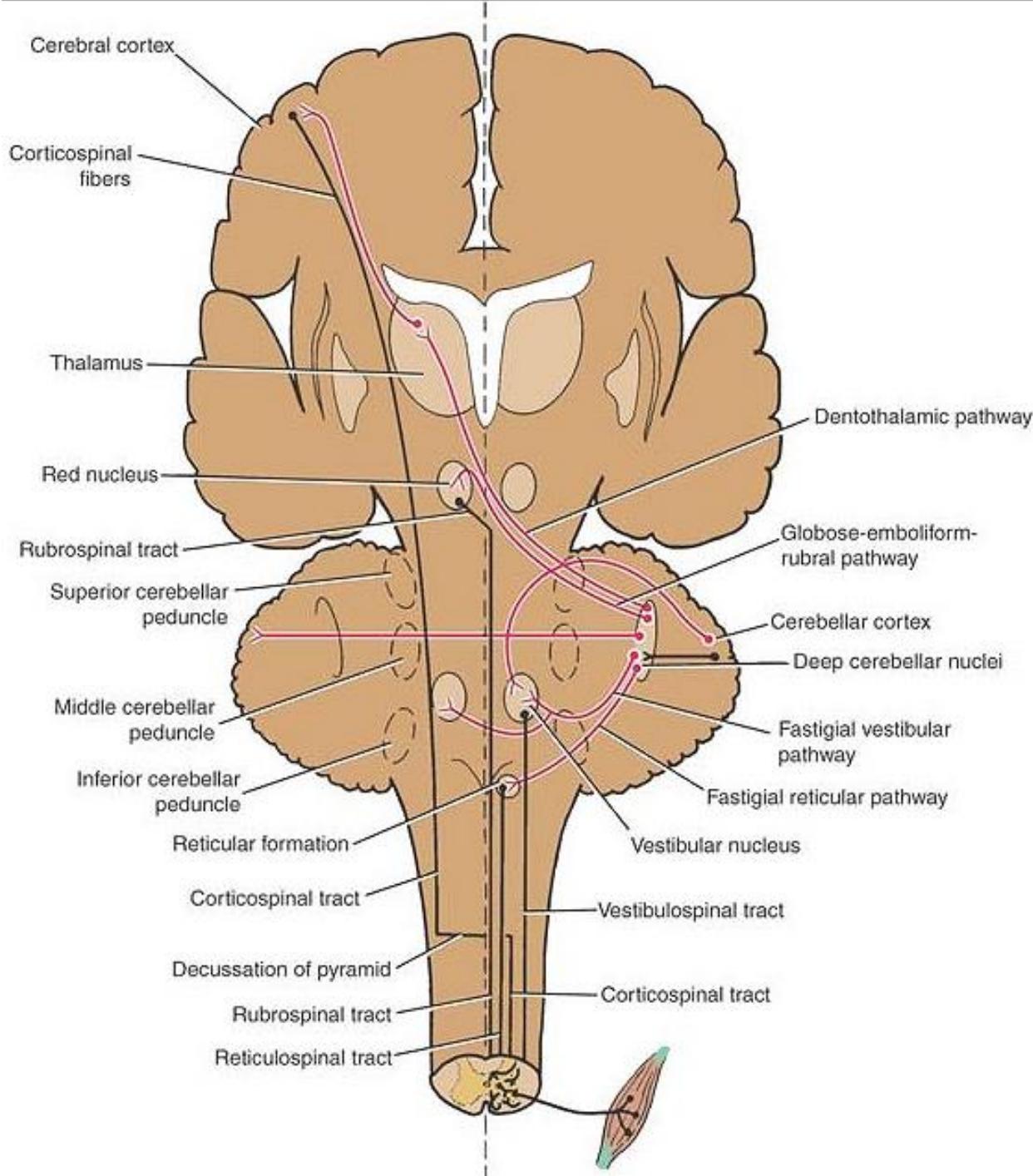
Afferent from cerebral cortex

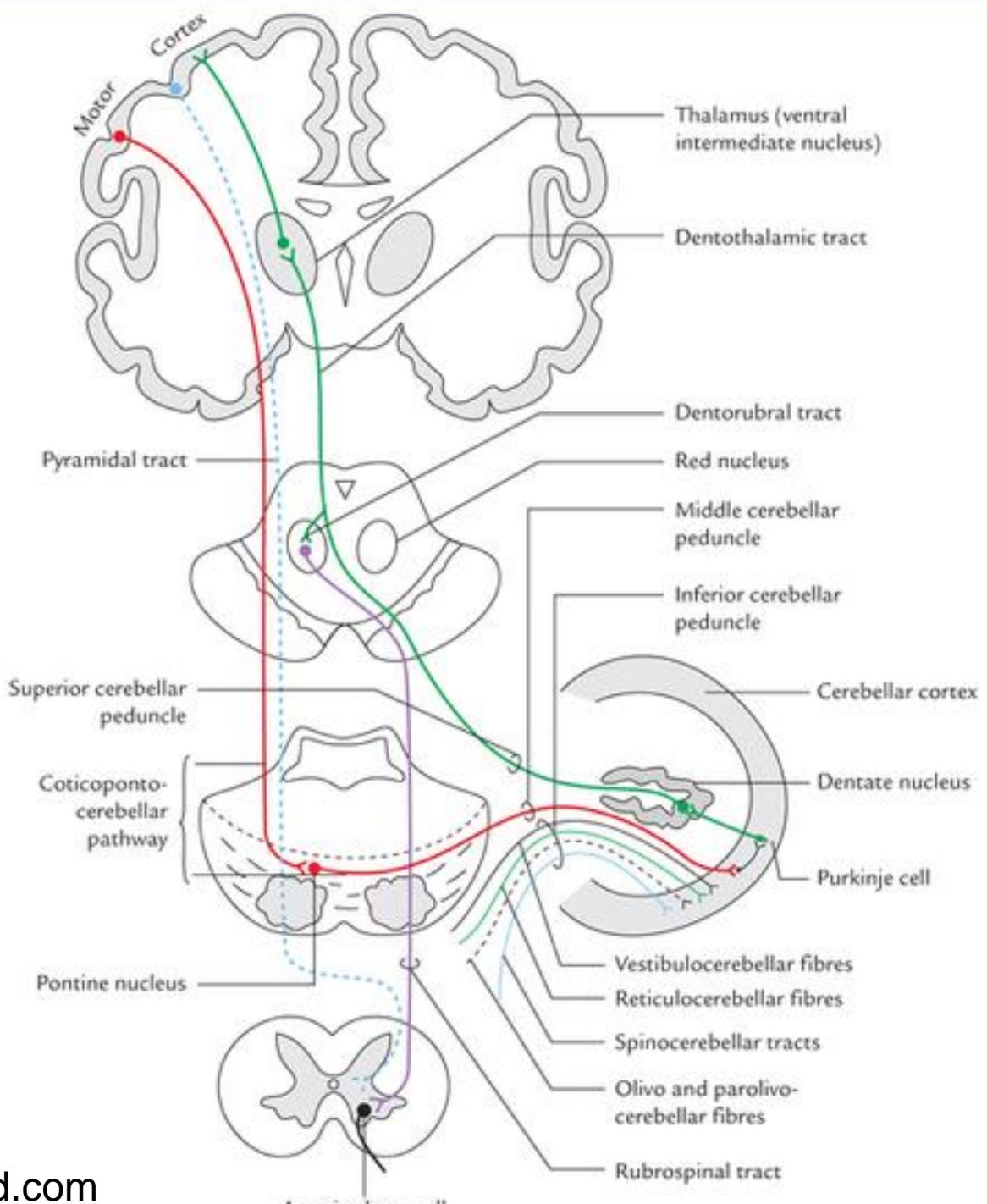


afferent from spinal cord

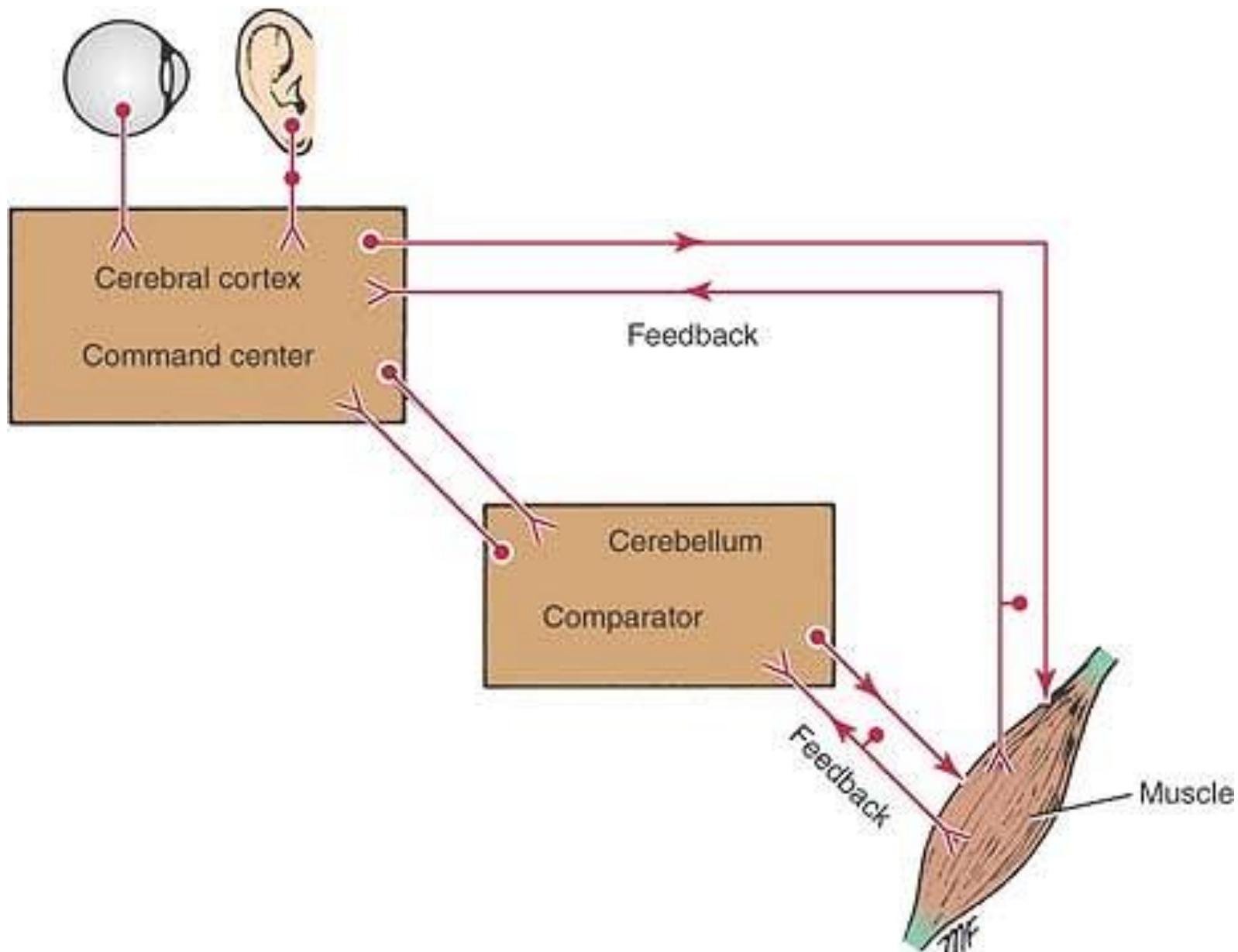


Cerebellar efferent fibers





Function



Functions of the cerebellum

- Maintenance of equilibrium.
- Regulation of muscle tone.
- Coordination of somatic motor activities.

Blood supply

- **Superior cerebellar artery**, a branch of basilar artery supplies the superior surface of the cerebellum.
- **Anterior inferior cerebellar artery**, a branch of basilar artery supplies the anterior part of the inferior surface of the cerebellum.
- **Posterior inferior cerebellar artery**, a branch of vertebral artery supplies the posterior part of the inferior surface of the cerebellum.

Sign & symptoms of cerebellar disease

- **Hypotonia**
- **Alteration of gait/ launching gait**
- **Ataxia-** intentional tremor
- **Dysdiadochokinesia-** inability to perform regular alternating movement
- Dysmetria
- **Dysarthria or scanning speech,** *i.e., speech is slurred, monotonous with pauses at wrong places.*